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| KENYON & KENYON LLP | | | NGUYEN, VU ANH | |
| ONE BROADWAY | | | | |
| NEW YORK, NY 10004 | | | | |
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|---------------------------------------|--|
| Office Action Summary | Application No. 10/560,125 | Applicant(s) HENNECK ET AL. | |
| | Examiner Vu Nguyen | Art Unit 1796 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 17-36 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 17-36 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. ____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>12/08/2005</u> . | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Claim Objections

1. Claims 20-22 and 26 are objected to because of the following informalities: The Markush groups are in improper format. Markush group format should be "selected from the group consisting of...and...". Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 28-31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
4. These claims recite weight ratios that involve those based on solutions. These ratios are ambiguous because the concentrations of the solutions are not defined.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 17, 19-22, and 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Osaka et al. (US 5,057,360) in view of Scheying et al. (WO 2001/044142), or Drumm et al. (US 2003/0098529), or Nonninger et al. (US 6,533,966).

Notes: US 2004/0106508 is being used an English equivalent of WO 2001/044142.

8. Regarding the limitations set forth in these claims, Osaka et al. (Osaka, hereafter) teaches a method for preparing a ceramic green sheet comprising (1) ball milling and kneading a mixture comprising 100 parts of a ceramic powder, 70 parts of a solvent mixture, and 1.5 parts of a dispersant, (2) adding to the resulting mixture 25 parts of a binder solution (45% solids content in toluene of an acrylatemethacrylate copolymer), 1 part of a plasticizer, and kneading, (3) removing air from the resulting slurry under vacuum and adjusting its viscosity, and (4) applying the slurry to a substrate using a doctor blade followed by heat treatment to produce a ceramic green sheet (col. 12, example 11). The solvent comprises acetone, MEK, methanol, ethanol, isopropanol, butanols, ethyl acetate, toluene, xylene, and mixtures thereof (col. 7, lines 41-56). The disclosed composition is judged to read on claims 28-31 since, as mentioned above, the claimed weight ratios are ambiguous. Since the prior art employs

a vacuum pump to remove air from the slurry, it is reasonable to expect that a portion of the volatile solvents is removed during that process.

9. Clearly, Osaka teaches all the limitations set forth in these claims but fails to teach an oxa acid as a co-dispersant.

10. Scheying et al. (Scheying, hereafter) teaches a ceramic-containing disperse substance comprising a ceramic component, a solvent, a dispersing agent, a binding agent, and a plasticizer (Abstract). The ceramic powder includes yttrium-stabilized zirconium oxide [0014]. The solvent includes high-boiling solvents such as alpha-terpineol [0015] and volatile solvent such as acetone [0017]. The dispersing agent is an organic acid that preferably includes trioxadecanoic acid [0018]. **[Motivations]** The disclosed ceramic powder dispersion method is said to break up the agglomerates so that the average particle size is highly reduced and the resulting particles are protected from reagglomeration [0023].

11. Drumm et al. (Drumm, hereafter) teaches nanoscale Al_2O_3 corundum ceramic powders and sintered compacts made therefrom (Title & [0002]). The dispersion of the alpha-alumina powder is performed by (1) dispersing the powder with the help of a dispersing agent/surface-modifying agent that includes a carboxylic acid such as trioxadecanoic acid [0016 & 0018] followed by (2) mixing with processing aids that include binders (such as acrylate polymers) and plasticizers (such as PEG) [0020]. **[Motivations]** Due to the use of the surface-modifying agent, the ceramic powder is highly redispersible [0019], making the powder dispersion particularly suitable for

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producing dense Al_2O_3 sintered bodies in the form of components of multilayered structures in systems such as microelectronics and piezoelectric sensors [0021].

12. Nonninger et al. (Nonninger, hereafter) teaches a method for preparing suspensions and powders of indium tin oxide, the method comprising (1) precipitating indium tin oxide precursors from solutions in one or more solvents in the presence of a surface-modifying agent, (2) removing the solvents and calcining the precipitate, (3) adding solvents and a surface-modifying agent to prepare a suspension, and (4) removing the liquid component to produce a powder, which is suitable for use in microelectronics and optoelectronics (Abstract). The surface-modifying agent of particular preference employed in the precipitating step and the powder dispersion step is 3,6,9-trioxadecanoic acid (col. 7, line 24; col. 8, line 45). **[Motivations]** Due to the use of such dispersing agent/surface-modifying agent, agglomeration of the primary particles into large aggregates is prevented (col. 8, lines 10-18; col. 3, lines 24-54 & 57-62; col. 4, lines 16-22).

13. In light of these teachings, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have employed an oxa acid such as 3,6,9-trioxadecanoic acid as a co-dispersant in the dispersion step taught by Osaka so that the surface of the particles is modified with this oxa acid and, consequently, agglomeration of the particles is prevented.

14. Claims 23 and 33-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Osaka et al. (US 5,057,360) in view of Scheying et al. (WO 2001/044142), or

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Drumm et al. (US 2003/0098529), or Nonninger et al. (US 6,533,966) as applied to claim 17 above, and further in view of McAlea et al. (WO 95/30503).

15. Regarding the limitations set forth in these claims, the method of claim 17 has been shown to be unpatentable over Osaka in view of Scheying, Drumm, or Nonninger as discussed above. However, Osaka is silent as to a mode of thermal decomposition of the binder and it employs a smaller plasticizer/binder ratio than the claimed ratio.

16. McAlea et al. (McAlea, hereafter) teaches binder compositions for selective laser sintering processes (Title). The binder compositions are designed to "impart the highest possible strength to the green parts" but that the binders are completely removed by thermal decomposition, leaving an insignificantly small amount of residual ash in the resulting metal/ceramic materials (Abstract & page 1). To minimize warpage and shrinkage (p. 4, last paragraph), the binders are removed by thermal depolymerization to avoid excessive debinding heat which would cause swelling of the ceramic powder (p. 8, lines 32-36; p. 9, lines 31-35). Small amount of binders is employed to avoid leaving void spaces in the final ceramic materials (p. 7, lines 25-26). To produce accurately shaped and acceptably strong green parts, the binders must be able to soften and flow at relatively low temperature and be thermally depolymerized and removed completely at relatively low temperature (p. 11, lines 3-23). The preferred binders are acrylatemethacrylate copolymers having tertiary carbon atoms located alternately along their backbones. Moreover, film-forming agents and plasticizers are added appropriately to lower the film-forming temperature of the binders and facilitate their "flow" at a relatively low temperature (p. 20).

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17. In light of such teachings, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified the method taught by Osaka by (1) employing an acrylatemethacrylate binder having tertiary carbon atoms located alternately along its backbone and (2) increasing the amount of the plasticizer/softener so that the binder can be softened at a relatively low temperature and can be removed by thermal depolymerization and, consequently, the resulting ceramic green sheet or material is less contaminated by residual binders and decomposition ash, is substantially free of warpage, shrinkage, and porosity, and has high strength, superior material integrity, and high dimensional stability.

18. Claims 18, 27, and 35-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Osaka et al. (US 5,057,360) in view of Scheying et al. (WO 2001/044142), or Drumm et al. (US 2003/0098529), or Nonninger et al. (US 6,533,966) as applied to claim 17 above, and further in view of Reddy et al. (Journal of Materials Science 37 (2002), 929-934).

19. Regarding the limitations set forth in these claims, the method of claim 17 has been shown to be unpatentable over Osaka in view of Scheying, Drumm, or Nonninger as discussed above. However, Osaka fails to teach a carboxylic acid groups-containing polymeric dispersant, PZT ceramic powder, and a piezo-multilayer actor.

20. Reddy et al. (Reddy, hereafter) discloses a study on the effect of type of solvent and dispersant on nano PZT powder dispersion for tape casting slurry (Title). The dispersion is prepared in a manner similar to the method taught by Osaka (section 2.4).

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The solvent includes three systems: toluene-ethanol, MEK-ethanol, and xylene-ethanol.

The dispersant includes triton x-100 and phosphate ester (Table II-IV). **[Motivations]**

Reddy teaches that PZT are of interest due to their ferroelectric and piezoelectric properties and that they are employed to prepare multilayer piezoelectric actuators. It is also taught that multilayer technology is highly desirable because it reduces the drive voltages (Introduction, 1st paragraph). Reddy also teaches that ceramic powder systems which are not fully deflocculated contain voids, which negatively affects the final product, and that effective dispersion of ceramic powder requires use of dispersants that provide steric and/or electrostatic stabilization (col. 2, 1st paragraph). In the same paragraph, it is revealed that steric stabilization is provided by polymeric dispersant of long chain molecule. The triton x-100 acts as a steric hindrant while the phosphate ester, which partially exists in anionically dissociated form, acts as a surface modifier via electrostatic interaction with the surface of the metal oxide particles (p. 932, right column).

21. In light of such teachings and considering that Scheying, Drumm, and Nonninger all employs a carboxylic acid for stabilizing metal oxide particles in a dispersion via surface modification mechanism, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified the method taught by Osaka by (1) employing PZT ceramic powder, (2) employing, as the dispersant, a combination of a carboxylic acid group-containing polymeric dispersant and a molecular carboxylic acid such as 3,6,9-trioxadecanoic acid so as to stabilize (i.e., prevent agglomeration) the ceramic powder by both steric and electrostatic effects, and

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(3) using the resulting dispersion to prepare a multilayer piezoelectric actuator so that the dispersion is fully deflocculated and, consequently, the resulting device is defect-free and has improved performance at reduced drive voltages.

22. Claims 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Osaka et al. (US 5,057,360) in view of Scheying et al. (WO 2001/044142), or Drumm et al. (US 2003/0098529), or Nonninger et al. (US 6,533,966) as applied to claim 17 above, and further in view of C&EN (<http://pubs.acs.org/cen/topstory/8005/8005notw5.html>) and the 2001 Danish Environmental Protection Agency (DEPA) Report (http://www2.mst.dk/common/Udgivramme/Frame.asp?http://www2.mst.dk/udgiv/Publications/2001/87-7944-407-5/html/default_eng.htm).

23. Regarding the limitations set forth in these claims, the method of claim 17 has been shown to be unpatentable over Osaka in view of Scheying, Drumm, or Nonninger as discussed above. However, Osaka fails to teach plasticizers that are adipates or citrates.

24. The Chemical and Engineering News disclosed in February of 2002 that a health study pointed to serious toxicity and health hazard of phthalate plasticizers. Plasticizer such as di-(2-ethylhexyl)phthalate (DEHP) was highly scrutinized.

25. In 2001, the DEPA Report showed that alternatives to phthalate plasticizers such as di(2-ethylhexyl)adipate and acetyl tributyl citrate are safe for use.

26. In light of these disclosures, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have replaced the harmful

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phthalate plasticizers employed by Osaka with di(2-ethylhexyl)adipate or acetyl tributyl citrate so as to avoid regulation-related costs and complications and the resulting products are safer.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vu Nguyen whose telephone number is (571)270-5454. The examiner can normally be reached on M-F 7:30-5:00 (Alternating Friday Off).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu can be reached on 571-272-1114. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Vu Nguyen
Examiner
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/David Wu/

Supervisory Patent Examiner, Art Unit 1796